

#14
09/348,142

CIP-2 (CIP-1 No: 09/348,142)

NEW DRAWINGS

Figures 1 thru 9

09/348,142

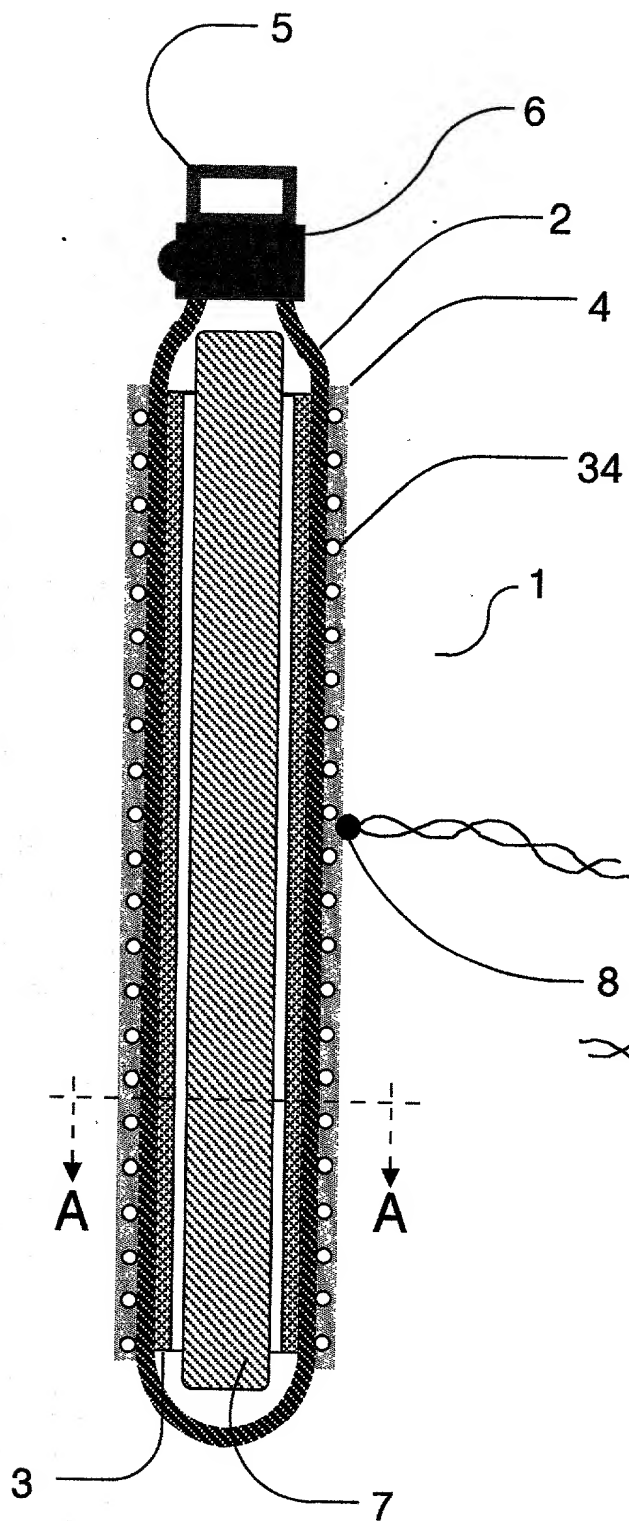


Fig. 1

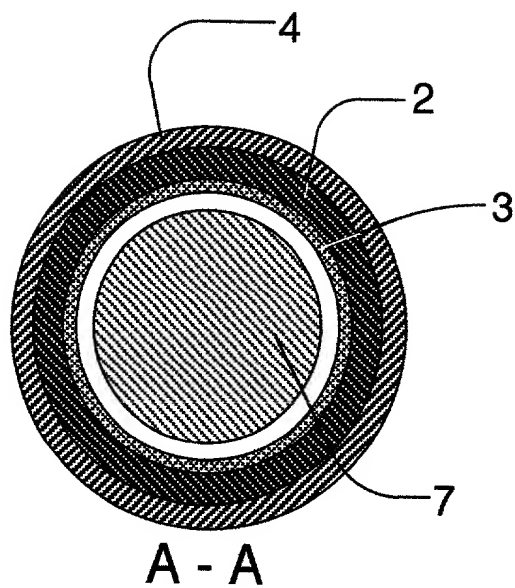


Fig. 3

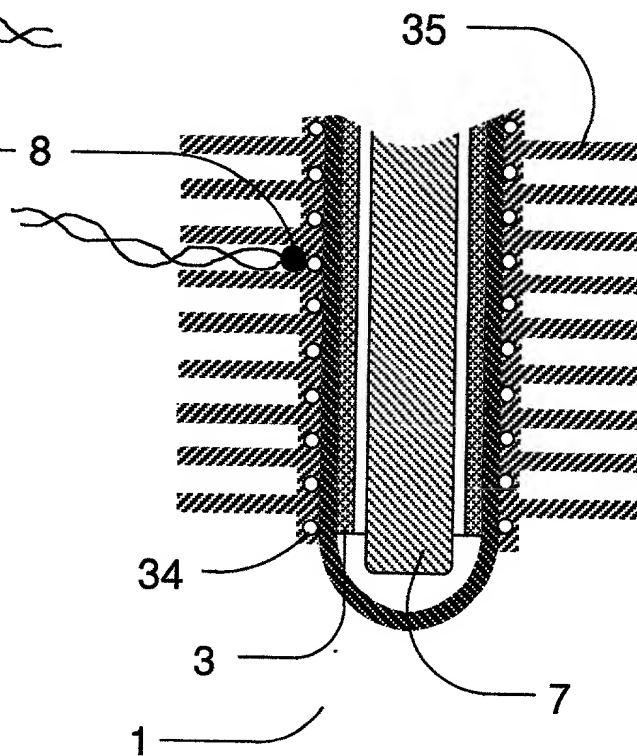


Fig. 2

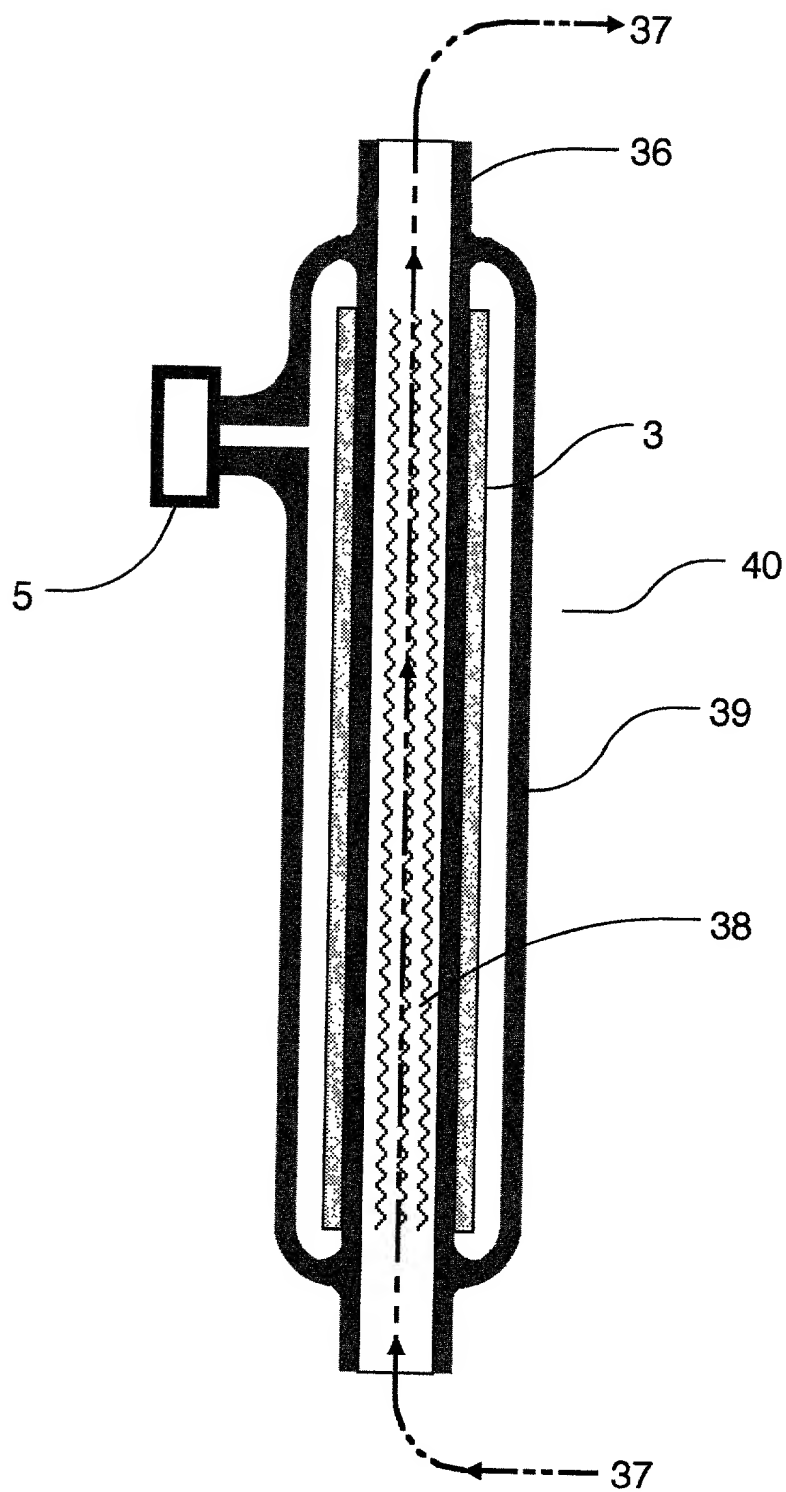


Fig. 4

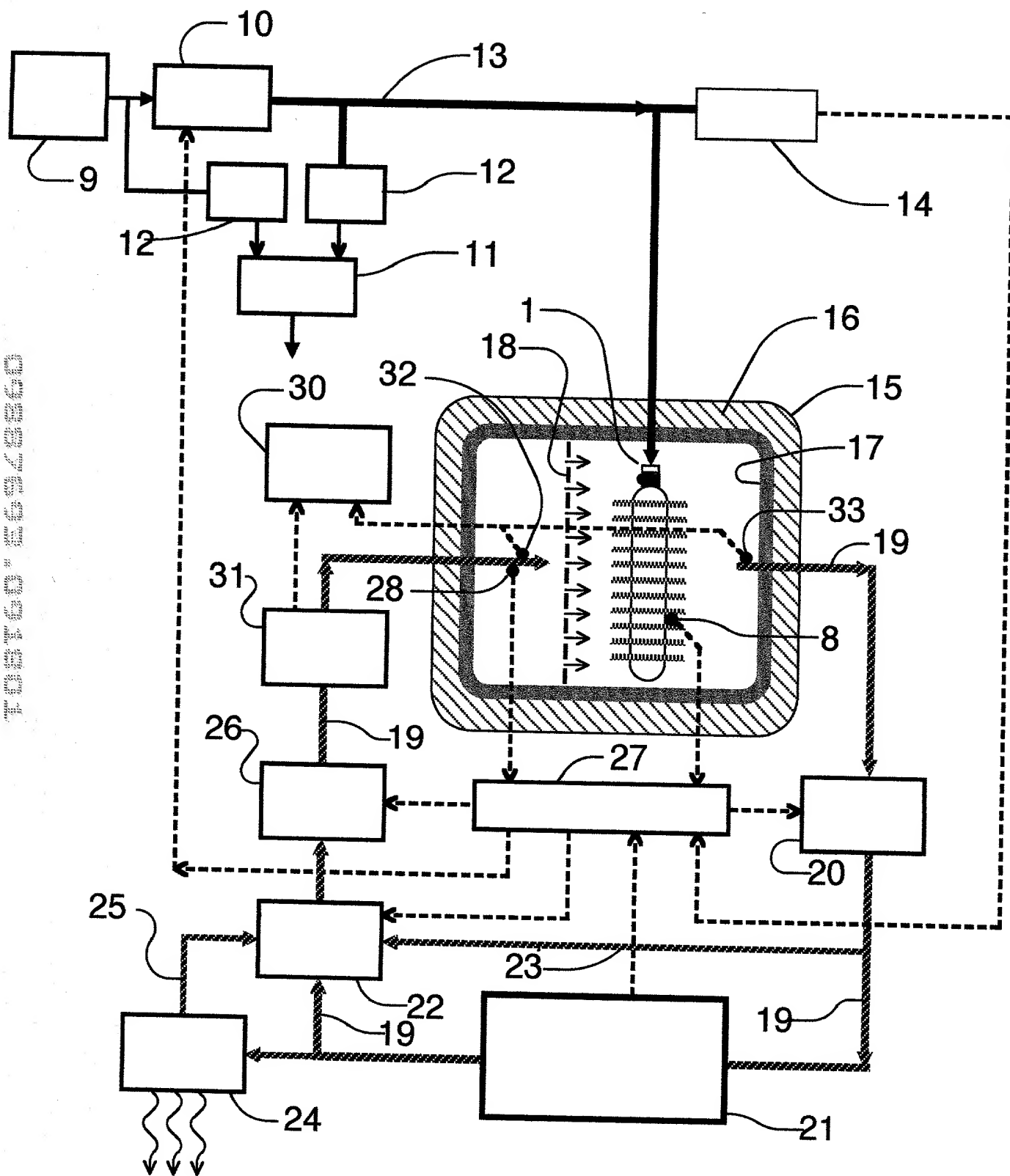


Fig. 5

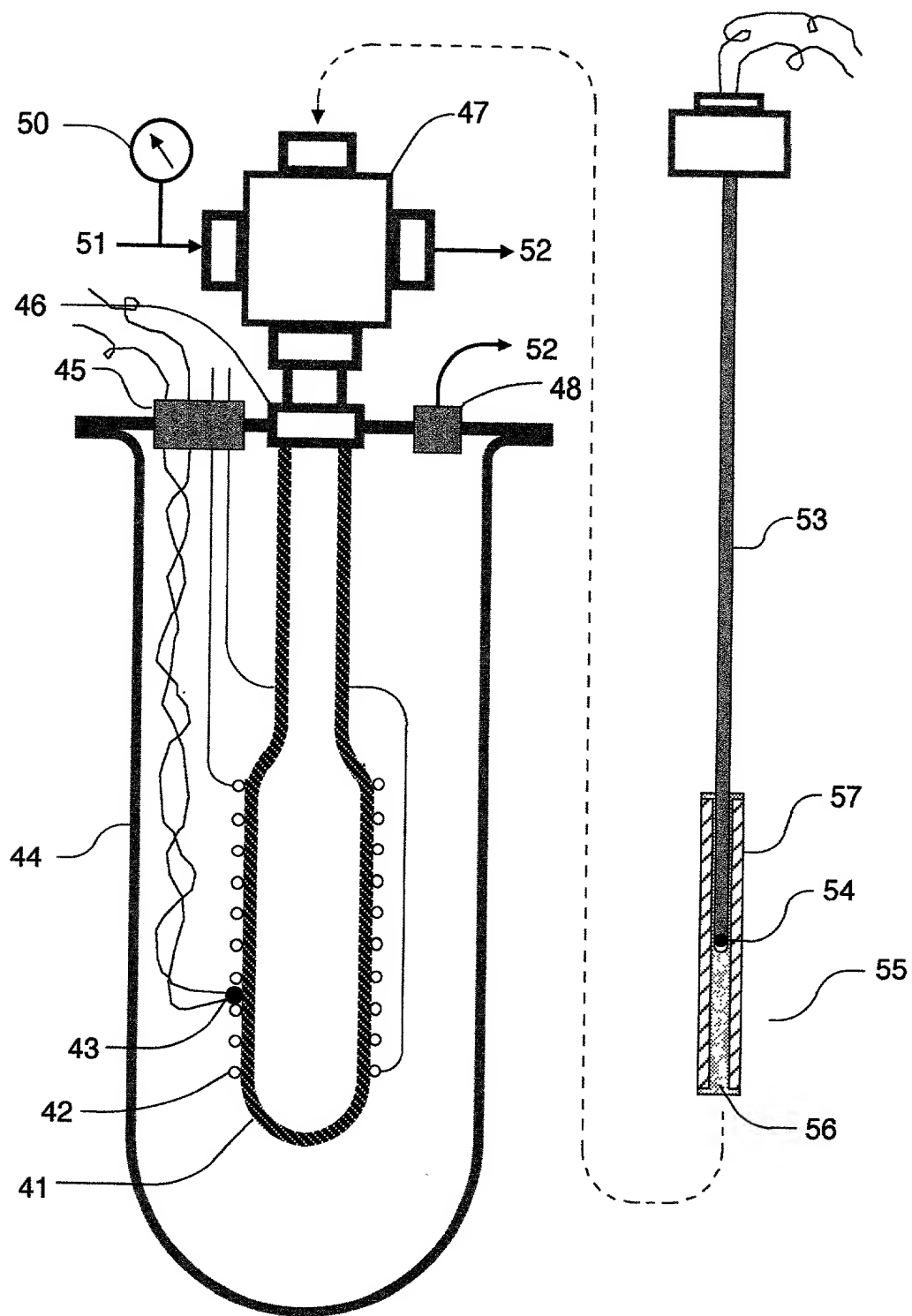


Fig. 6

System Free Energy State

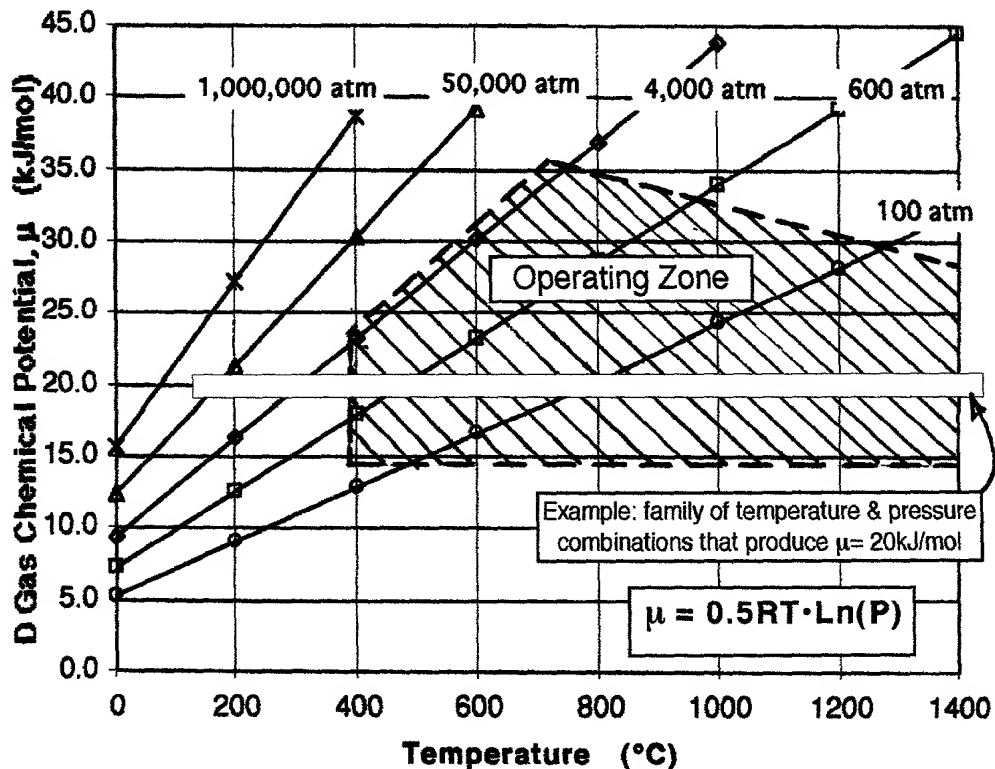


Fig. 7

Notes:

1. For any given system free energy state and corresponding D chemical potential value, there is a family of temperature and pressure combinations that will produce that same value.
2. The above operating temperature range applies when the host metal has a melting point in the 1500°C range.
3. A broader operating zone is available if one is willing and able to:
 - a. use higher pressures to operate at lower temperatures.
 - b. use thicker reactor body walls to use higher temperatures or higher pressures.
 - c. use higher temperature materials, such as tungsten, for the reactor body to achieve D chemical potentials in the 60 kJ/mol range and operating temperatures in the 3000°C range.

REF ID: A63686

D-Pd TCP Equilibrium Diagram

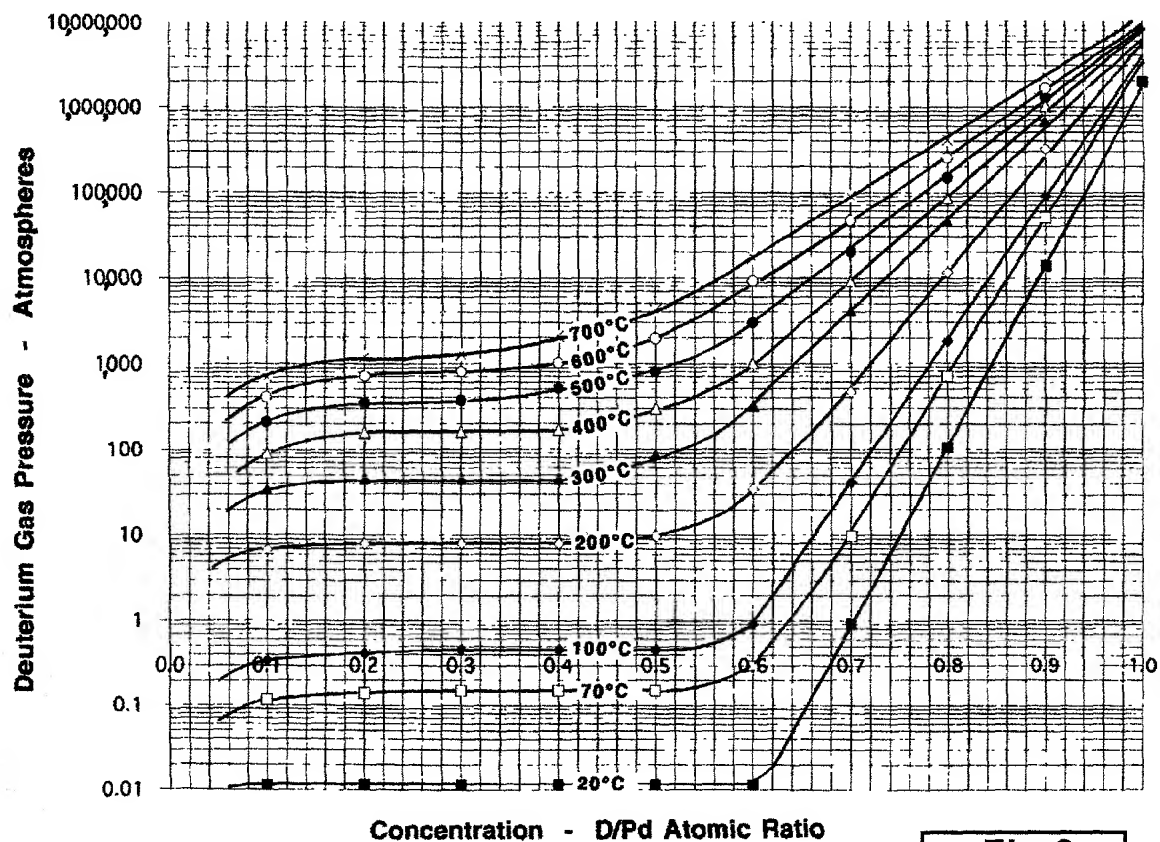


Fig 8

Notes:

1. Any point on this diagram represents the temperature, pressure and concentration when the gas phase and the solid phase are in equilibrium.
2. At equilibrium, the deuterium gas chemical potential is equal to the chemical potential of the dissolved deuterium and the concentration is uniform throughout the solid.

Experimental Data

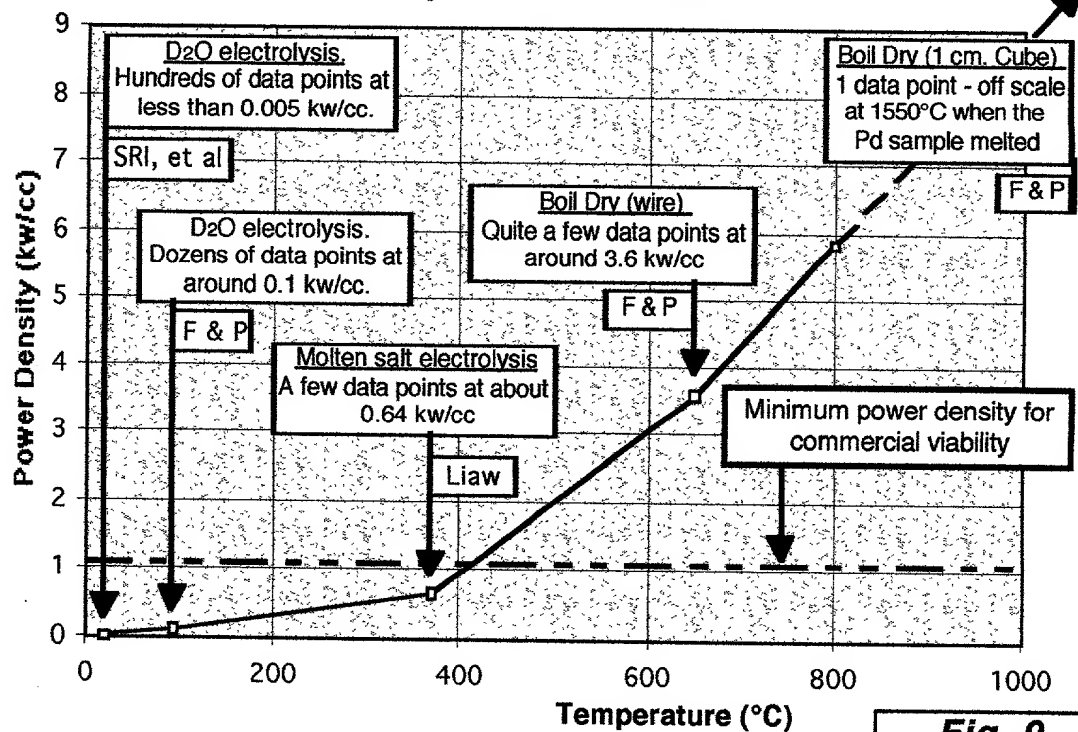


Fig. 9

"Boil Dry" Experiments

- High density heat is produced at high temperatures and at very high free energy states when the electrolytic process is stopped.
- A 'boil dry' experiment starts with a standard Pd-D₂O electrolytic cell which is producing excess heat and the electrolyte is allowed to boil off. Once the electrolyte is gone and the electrolysis stops, the cathode is operating like a 'gas loaded' reactor but without control of the temperature, gas pressure or the heat transfer rate. Without the liquid, the heat transfer coefficient decreases remarkably and it is no longer possible for all of the generated heat to be transferred out of the Pd. The result is the Pd cathode experiences positive temperature feedback creating an out-of-control condition.
- To make the instability worse, the higher temperatures cause an increase in the rate of the fusion reaction. It is the outward diffusion of the ionic deuterium and depletion of the reacting deuterium that eventually brings the episode to an end.
- **The present invention provides the means and the methods to duplicate the free energy states present when the above experiments produced high density heat but provides stable operation.**

CIP-2 (CIP-1 No: 09/348,142)

NEW DRAWINGS

Figures 1 thru 6

Informal version with words

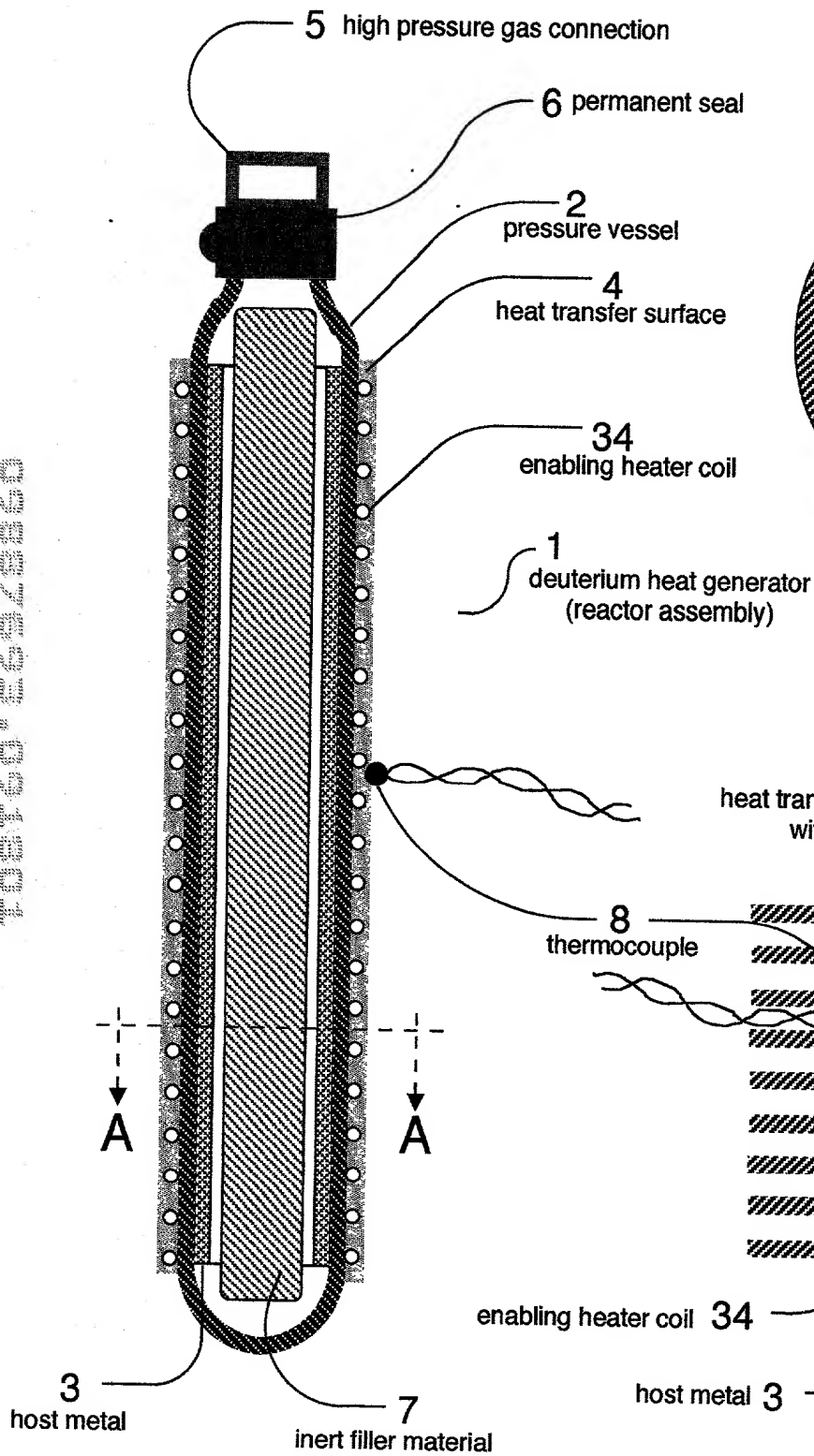


Fig. 1

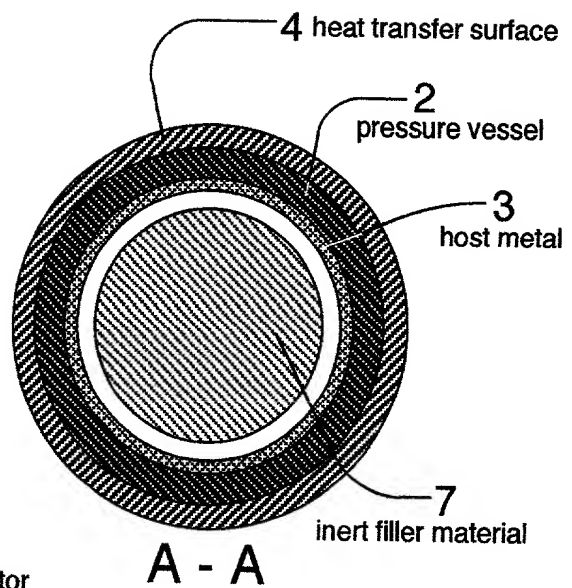


Fig. 3

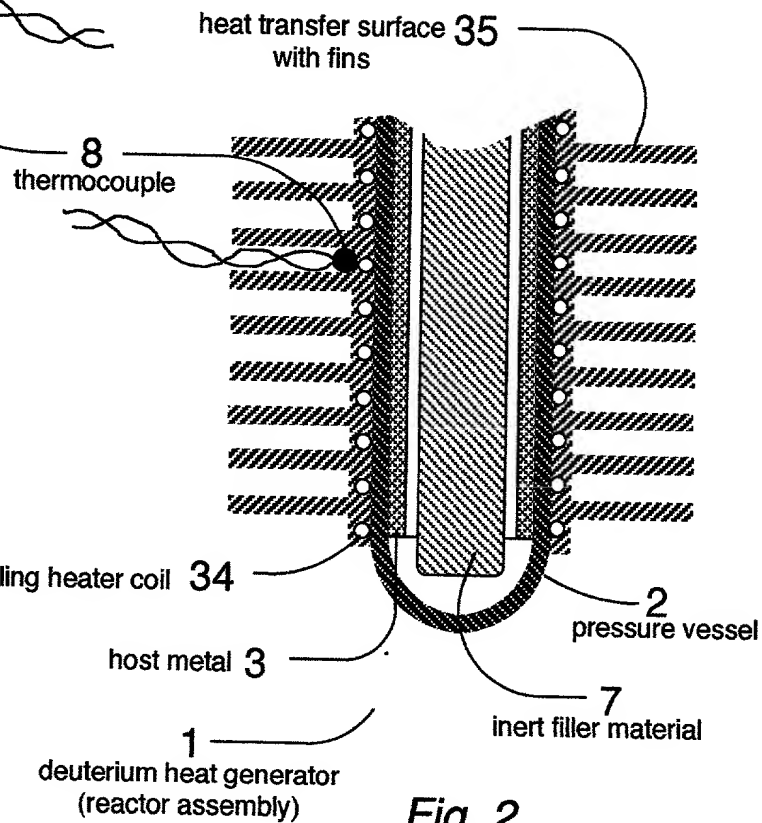


Fig. 2

**Typical Alternate Arrangement for the
Host Metal & Heat Transfer Surface**

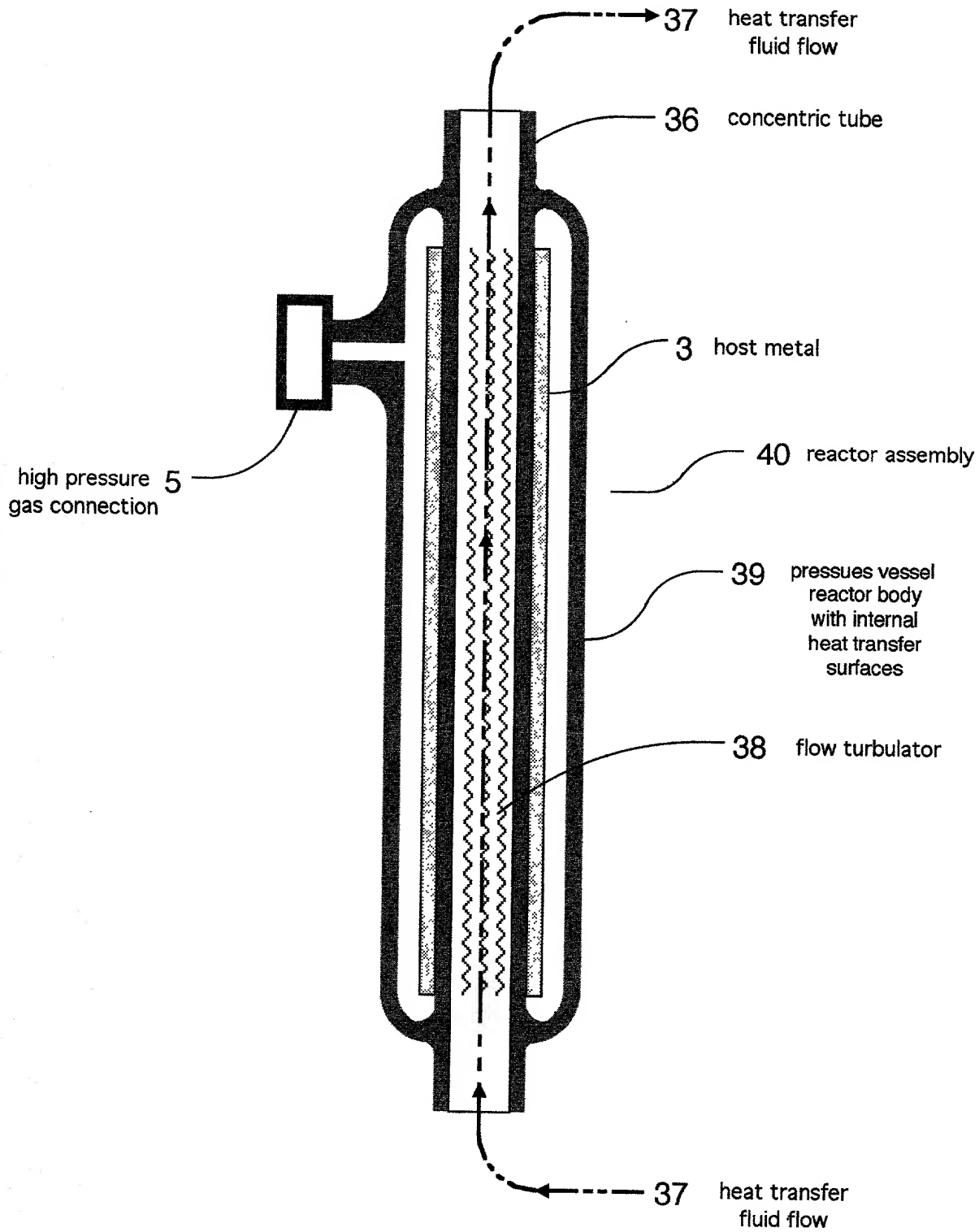


Fig. 4

The diagram illustrates a reactor system with a heat transfer fluid circulation path. Key components and their functions are as follows:

- Gas Storage (9):** Provides gas to the **pressurizing equipment (10)**.
- Pressurizing Equipment (10):** Connects to a **high pressure manifold (13)**.
- Isolation Valves (12):** Control flow between the manifold and the **vacuum pumps (11)** and the **reactor assembly (1)**.
- Vacuum Pumps (11):** Maintain low pressure within the reactor assembly.
- Reactor Assembly (1):** Contains a **reactor (1)** and a **flow distributor (18)**. It is surrounded by **insulation (16)** and has an **operating chamber (15)** with a **heater (17)**.
- Temperature Sensors:** **inlet temp (32)** and **outlet temp (33)** are located within the reactor assembly. **host temp (8)** is located in the heat transfer fluid circulation path.
- Heat Transfer Fluid Circulation Path (19):** A closed loop system for heat exchange.
 - Heat Transfer Fluid Pump (20):** Circulates the fluid from the reactor outlet (33) through the **heat-using devices (load) (21)** and back to the reactor inlet (32).
 - Control (27):** Receives temperature feedback and controls the **flow rate control valve (26)** and the **heat transfer fluid pump (20)**.
 - Flow Rate Control Valve (26):** Regulates the flow of heat transfer fluid.
 - Mixing Valve (22):** Combines the heat transfer fluid with a **cooling by-pass (25)** stream before it enters the reactor inlet (32).
 - Heat Rejection (cooling) (24):** Removes excess heat from the cooling by-pass stream.
 - Heating by-pass (23):** Allows heat transfer fluid to bypass the heat-using devices and return to the reactor inlet.
- Calorimeter (30):** Measures the heat flow of the fluid entering the reactor.
- Mass Flowmeter (31):** Measures the mass flow rate of the fluid entering the reactor.
- Pressure Transducer (14):** Monitors the pressure within the high pressure manifold (13).

Fig. 5

Typical Scanning Reactor Arrangement

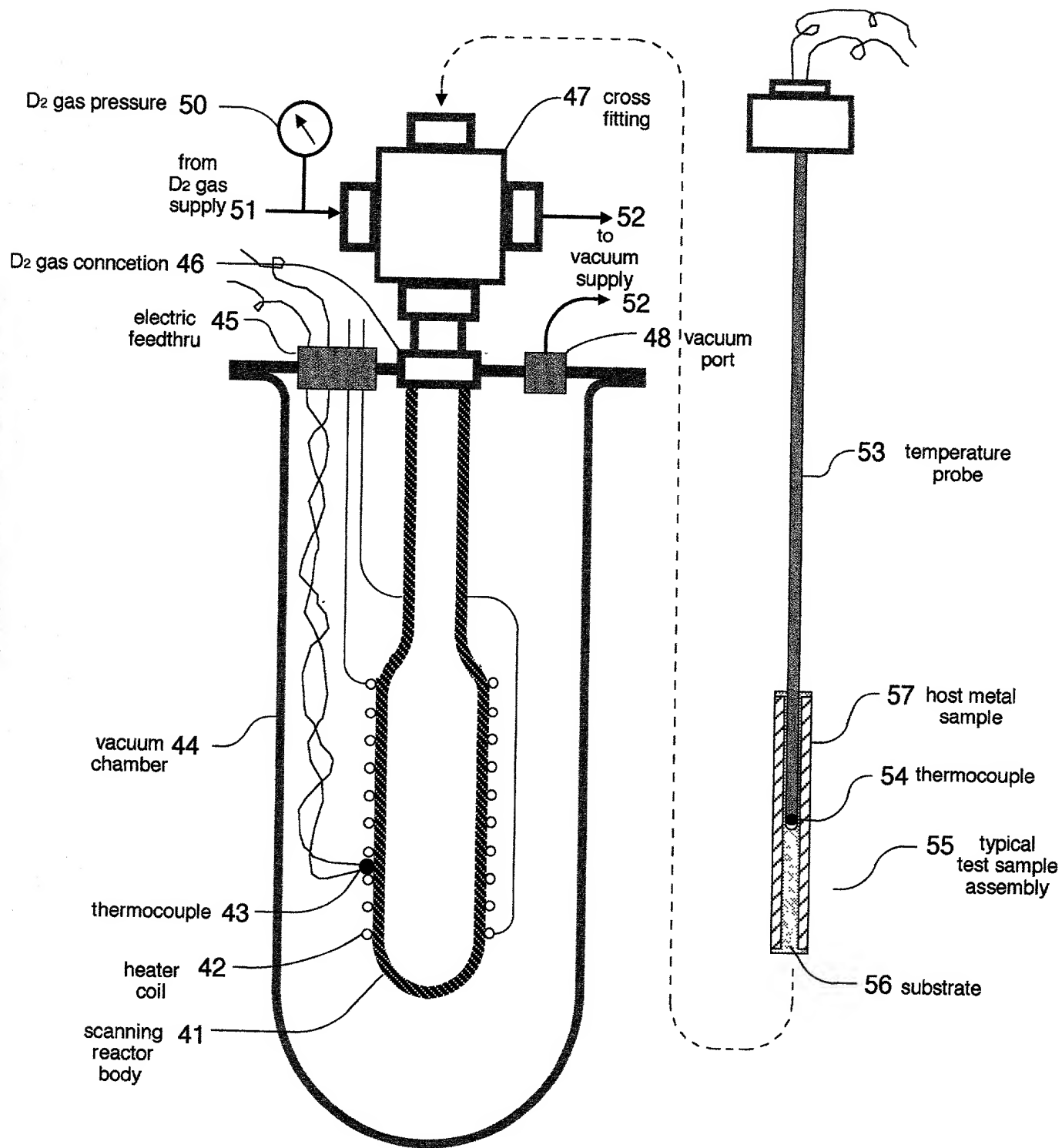


Fig. 6